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New and noteworthy *Entoloma* species from the Primorsky Territory, Russian Far East

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Abstract — An account is given of some new and interesting *Entoloma* species collected in the Primorsky Territory of the Russian Far East. Six species (*Entoloma eugenei, E. kedrovense, E. pallidocarpum, E. angustispermum, E, pallidoflavum, E. subcaesiellum*) are new to science and their taxonomic position is discussed. In addition some interesting records of other species are documented.

Key words — *Entolomataceae*, new species, Kedrovaya Pad Nature Reserve

Introduction

Entoloma is the second largest genus of *Agaricales*. It is monophyletic (Co-David et al. 2009) and highly variable in morphological characters. It is estimated to contain more than 1500 species and is found worldwide, from arctic to tropical habitats (Largent 1977, 1994, Romagnesi & Gilles 1979, Horak 1980, 2008, Noordeloos 1981, 1992, 2004, Manimohan et al. 2006, Gates & Noordeloos 2007, Noordeloos & Hausknecht 2007, Noordeloos & Gates 2009). However, large areas are still under-explored, particularly in Africa, South America, India, and S.E. Asia.

The present paper gives an account of some new and interesting species collected by the second author in the Primorsky Territory, Russian Far East. Vassiljeva (1973), who provided the most complete data on *Entoloma* in this Territory, supplied descriptions and partly illustrated 34 species. Additional information can be found in the checklists of Nature Reserves of the Russian Far East and other papers (Azbukina & Kharkevich 1984, Egorova 2002, Vassiljeva & Bezdeleva 2006, Morozova 2007). The full list of literature devoted to the

mycobiota of this territory can be found in Bulakh (2005). In total, 52 species of *Entoloma* are known up to the present day for the Russian Far East.

The Kedrovaya Pad Nature Reserve is located at the southern tip of the Primorsky Territory in the spurs of the Eastern-Manchurian Mountains that extend eastward into Russia from China and North Korea. Its name originates from the Kedrovaya River, which flows through it. The reserve lies in the monsoon climate zone, and the warm, humid air masses from the Philippines combined with the mountainous relief play a significant role in creating a microclimate within the reserve. The vegetation of the Nature Reserve unites elements of the taiga and subtropical forests, but a southern flora predominates. Coniferous-broadleaved forests represent the native vegetation type, which today covers just over ten percent of the reserve's total area. Dominated by Manchurian firs (*Abies holophylla* Maxim.), these forests also incorporate warmth-loving trees such as *Quercus mongolica* Fisch. ex Turcz., *Tilia amurensis* Rupr., *T. mandshurica* Rupr. & Maxim., and *Fraxinus rhynchophylla* Hance. Forests of *Quercus mongolica* occupy nearly half of the territory and represent mostly secondary vegetation together with *Acer mono* Maxim., *Betula dahurica* Pall., *B. lutea* Michx., *Tilia amurensis*, *T. mandshurica*, and *Ulmus laciniata* Mayr. The valleys are occupied by *Alnus hirsuta* Turcz., *Chosenia arbutifolia* (Pall.) A.K. Skvortsov, *Fraxinus rhynchophylla, Populus maximowiczii* Henry, *Salix schwerinii* E.L. Wolf, *S. gracilistyla* Miq., *Ulmus laciniata*, and *U. japonica* (Sarg. ex Rehder.) Sarg. (Vasilyev et al. 1984). As can be expected from the geographic position of this area, the *Entoloma* flora appears to be Eurasian in character, with western and eastern elements.

Materials and methods

The specimens were collected, documented and preserved using standard methods. Macroscopic descriptions are based on the study of the fresh material as well as on analysis of the photos. The dried material was examined using standard microscopic techniques. Spores, basidia and cystidia were observed in squash preparations of small parts of the lamellae in 5% KOH or 1 % Congo Red in concentrated NH_4OH. The pileipellis was examined in a preparation of the radial section of the pileus in 5% KOH. Microscopic measurements and drawings were made with Micmed 2–2 and AxioImager A1 microscopes. Basidiospore dimensions are based on observing 20 spores, cystidia and basidia dimensions on observing at least 10 structures per collection. Spore length to width ratios are reported as Q. The collected material is deposited in the National Herbarium of the Netherlands (L) and in the Mycological Herbarium of the Komarov Botanical Institute (LE).

Plate 1. 1. *Entoloma eugenei* (holotype). 2. *E. kedrovense* (holotype). 3. *E. pallidocarpum* (holotype). 4. *E. angustispermum* (holotype). 5. *E. subcaesiellum* (holotype). 6. *E. roseoflavum* (holotype). 7. *E. caesiellum* (LE 253780). 8. *E. parasericellum* (LE 253788) . 9. *E. gomerense* (LE 253784).

Taxonomy

I. New taxa

1. *Entoloma eugenei* Noordel. & O.V. Morozova, **sp. nov.** Fig. 1, Plate 1.1.

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Pileus 13–45 mm latus, semiglobosus demum convexus, plano-convexus, margine involuto, haud hygrophanus, haud translucente striatus, toto velutinus, juventute cyaneus demum margine violaceo. Lamellae adnato-emarginatae, albae demum rosae acie concolor. Stipes 30–80 × 4–8 mm, clavatus vel cylindraceus basi incrassata, squamuliscum, pileo concolor, apice violaceo, basi albotomentosa. Caro albida. Odor paulum acer. Sapor nullus. Sporae 10.0–12.5 × 6.0–8.0 µm, Q = 1.3–1.7, 5–7 angulatae. Basidia 34–44 × 9–12 µm tetrasporigera fibulata. Acies lamellarum sterilis. Cheilocystidia 28.5–37.5 × 6.5–15.5 µm, cylindracea vel leviter lageniformia. Pileipellis trichoderma elementis terminalibus 90–200 × 12–20 µm pigmento caeruleo intracellulari. Fibulae abundantes. Granula lucentia desunt. Habitat ad terram in silva frondosa humida.

Holotypus: RUSSIA; Primorsky Territory, Kedrovaya Pad Nature Reserve, the right bank of the Kedrovaya River, 43°05'51" N, 131°33'34" E, 24 Aug. 2005, *leg. E. Popov, LE 253771.*

Etymology: this species is named in honor of Dr Eugene Popov for his support.

Macrocharacters — Pileus 13–45 mm broad, hemispherical expanding to plano-convex with incurved margin, not hygrophanous, not translucently striate, entirely velvety when young, becoming glabrous at the margin, uniformly deep blue (Indian blue) at first, then with violet tinge at margin, dry. Lamellae adnate-emarginate with decurrent tooth, pure white in youth becoming pink, with irregular concolorous edge. Stipe 30–80 × 4–8 mm, clavate or cylindrical with swollen base (to 15 mm), concolourous with the pileus or slightly paler, entirely squamulose with concolorous squamules, base with white tomentum. Flesh white, dark blue beneath the surface. Smell slightly spicy. Taste mild.

Microcharacters — Spores 10.0–12.5 × 6.0–8.0 µm, Q = 1.3–1.7, heterodiametrical, with 5–7 angles in side view. Basidia 34–44 × 9–12 µm, clavate, clamped. Lamellae edge sterile. Cheilocystidia 28.5–37.5 × 6.5–15.5 µm, cylindrical, narrowly lageniform or irregularly shaped, colourless. Hymenophoral trama regular, made up of cylindrical to inflated elements, 10–20 µm wide. Brilliant granules absent. Pileipellis a trichoderm of cylindrical hyphae with terminal elements 90–200 × 12–20 µm. Pigment blue, intracellular. Clamp connections abundant in pileipellis.

Habitat — On soil in the flood plain forest.

Comments — *Entoloma eugenei* is a striking blue species in section *Leptonia*, characterized by the trichodermal pileipellis with clamp connections. It is close to the European *E. dichroum* (Pers.) P. Kumm. and *E. tjallingiorum* Noordel. and the North American *E. cyaneum* (Peck) Sacc., from which it differs in

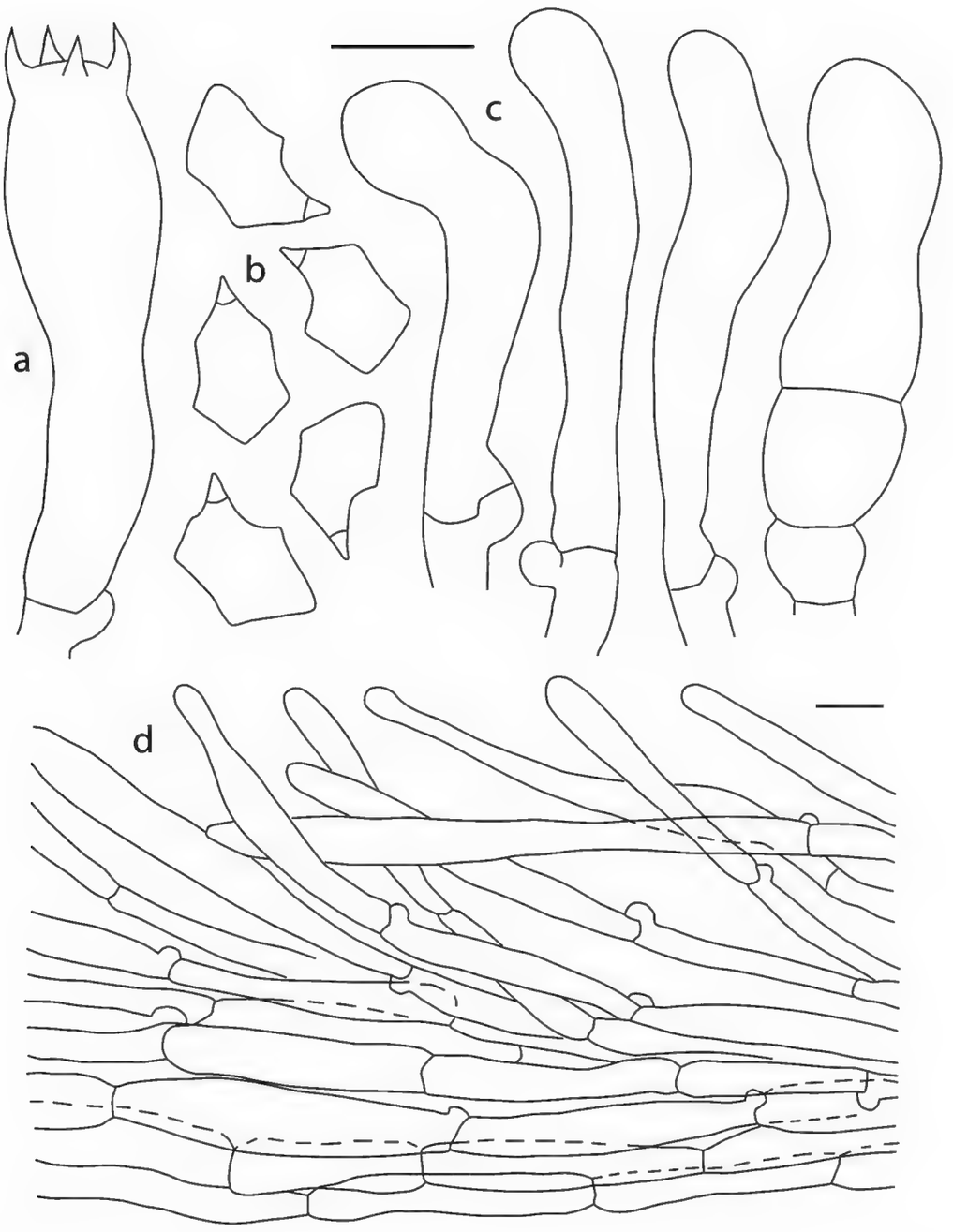

Fig. 1. *Entoloma eugenei*. Basidium (a), spores (b), cheilocystidia (c), and pileipellis (d). All figs from holotype. Bar = 10 μm.

the deep blue colour, strongly contrasting white lamellae, and shape of the spores and cheilocystidia. *Entoloma egregium* E. Horak from New Guinea is macroscopically similar but differs with respect to spore shape, cheilocystidia and pileipellis structure. *Entoloma panniculus* (Berk.) Sacc. from Australia is similarly colored but produces smaller spores and different pileipellis pigments (Berkeley 1859).

2. *Entoloma kedrovense* Noordel. & O.V. Morozova, **sp. nov.** FIG. 2, PLATE 1.2

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PILEUS 15–30 mm latus, conicus vel semiglobosus demum convexus, plano-convexus, haud hygrophanus, paulisper translucente striatus, obscure griseobrunneus, juventute tomentosus, demum centro squamuloso, margine fibrilloso-rimoso. LAMELLAE adnato-emarginatae, paulo dente decurrentes, albae demum rosae acie concolor. STIPES 70–90 × 2.5–4 mm, cylindraceus vel compressus, griseo-caeruleus, longitudinaliter fibrillosus, apice squamuliscum, basi albotomentosa. CARO superficie concolor odore saporeque indistinctis. SPORAE 8.0–11.2 × 6.0–7.5 µm, Q = 1.3–1.6, 5–6 angulatae. BASIDIA 21.5–37.0 × 12–13.5 µm tetrasporigera efibulata. ACIES lamellarum heterogenea, cheilocystidia 18–27 × 5–9 µm, cylindracea, clavata vel formae irregularis. PILEIPELLIS cutis trichoderma transient, centro trichoderma vel hymeniderma elementis terminalibus inflatis 25–80 × 7–19 µm pigmento griseobrunneo intracellulari; fibulae desunt. GRANULA LUCENTIA abundantia. HABITAT ad terram in silva frondosa humida.

HOLOTYPUS: RUSSIA; Primorsky Territory, Kedrovaya Pad Nature Reserve, the right bank of the Kedrovaya River, 43°05'56" N, 131°33'21" E, 17 Aug. 2005, *leg. O. Morozova, LE 253772.*

ETYMOLOGY: named after the type locality — valley of the Kedrovaya River.

MACROCHARACTERS — PILEUS 15–30 mm broad, conical to hemispherical, then convex to plano-convex, with minute pointed umbo, never distinctly umbilicate, not hygrophanous, slightly translucently striate at margin only, dark grey-brown, tomentose when young, breaking up into rather coarse squamules at centre, with smaller, rather regularly distributed squamules towards margin, on paler brown background, sometimes with a slight purple tinge. LAMELLAE adnate-emarginate with small decurrent tooth, whitish then pink with concolourous edge. STIPE 70–90 × 2.5–4 mm, cylindrical or compressed with longitudinal groove, mouse gray or, sometimes with purplish tinge, minutely squamulose in the upper half grayish blue, longitudinally fibrillose in the lower part, base with white tomentum. CONTEXT concolorous with the surface, whitish in the inner part. ODOUR indistinct. TASTE indistinct.

MICROCHARACTERS — SPORES 8.0–11.2 × 6.0–7.5 µm, Q=1.3–1.6, heterodiametrical, with 5–6 angles in side view. BASIDIA 21.5–37.0 × 12–13.5 µm, clavate, clamps not seen. LAMELLAE edge heterogeneous. CHEILOCYSTIDIA 18–27 × 5–9 µm, cylindrical to clavate or irregularly shaped, septate, colourless. Brilliant granules abundant in hymenophoral- and pilei-trama. PILEIPELLIS cutis with transition to a trichoderm, in central part more like a trichoderm or hymeniderm of inflated terminal elements, 25–80 × 7–19 µm. Pigment dark grey-brown, intracellular. CLAMP CONNECTIONS absent.

HABITAT — On soil in the flood plain forest.

COMMENTS — *Entoloma kedrovense* is distinguished by the dark grey squamulose pileus and floccose, blue-grey stipe. It keys out in series *Anatinum* of section *Cyanula* (Noordeloos 1992). *Entoloma coeruleoflocculosum* Noordel. has a deep

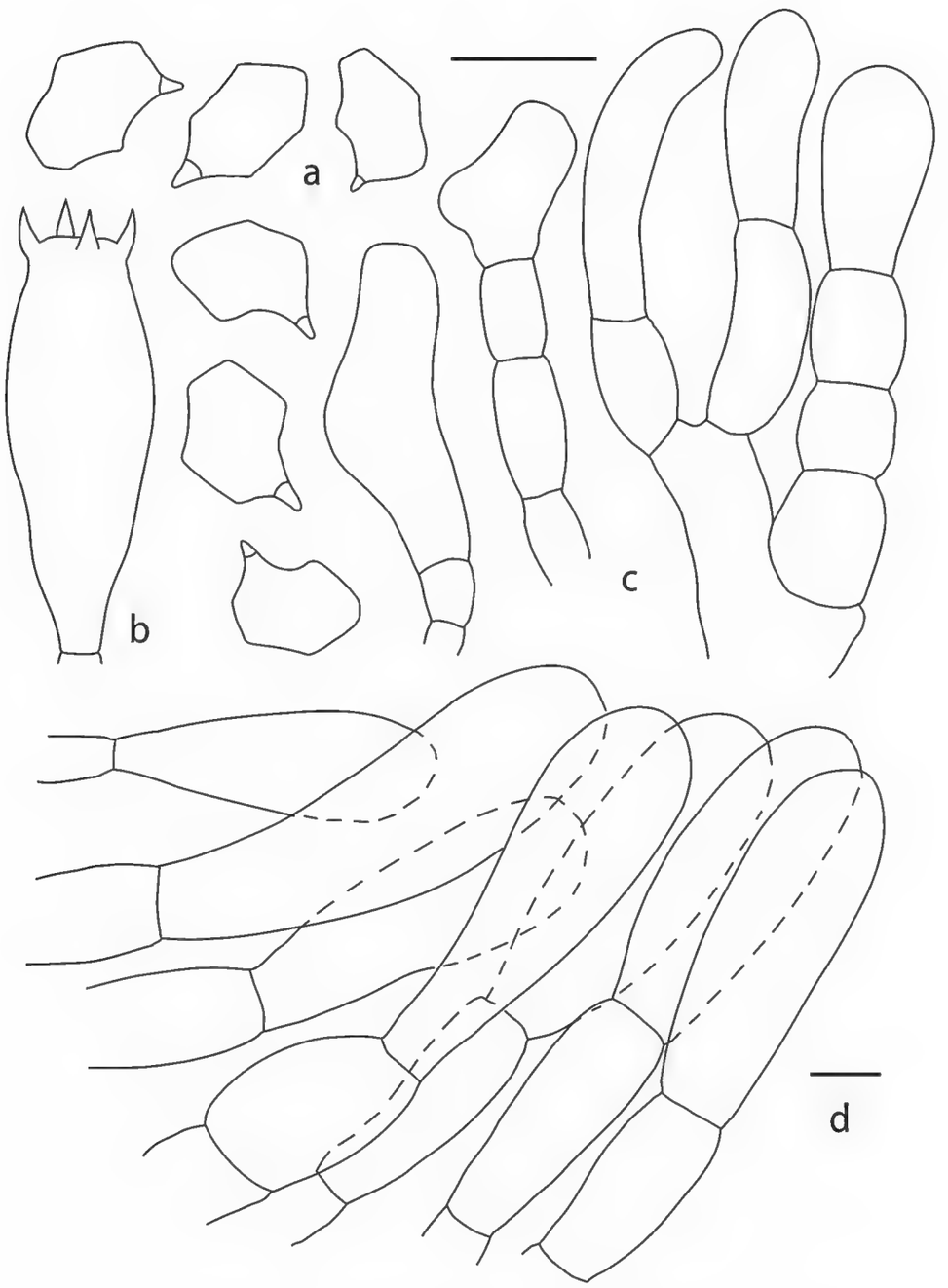

Fig. 2. *Entoloma kedrovense*. Spores (a), basidium (b), cheilocystidia (c), and pileipellis (d). All figs from holotype. Bar = 10 μm.

reddish brown pileus and a completely sterile lamella edge, often with brown intracellular pigment. *Entoloma mougeotii* (Fr.) Hesler has a more violaceous-grey pileus and stipe, a more regularly tomentose-squamulose pileus, and a completely sterile lamella edge. In Largent (1977) this species keys out in series *Paludocybe*, close to *Leptonia gracilipes* Peck, which, however, differs among other things by having a polished, glabrous stipe. None of the Asian species in Horak (1980) fits with our species.

3. ***Entoloma pallidocarpum*** Noordel. & O.V. Morozova, **sp. nov.** Fig. 3, Plate 1.3

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Pileus 80–130 mm latus, plano-convexus, centro applanato margine recto, hygrophanus, paulisper translucente striatus, pallide brunneolus, in sicco striis radialibus pallescens, glaber, radiatim rugulosus. Lamellae confertae, adnato-emarginatae, ad 10 mm late, albae demum rosae acie denticulata concolor. Stipes 140–160 × 17–20 mm, cylindraceus, firmus, albus, innate longitudinaliter fibrillosus basi albotomentosa. Caro albo odore saporeque leviter farinaceis demum nucis. Sporae 7.0–9.2 × 6.0–7.5 µm, Q = 1.0–1.3, 6–7 angulatae. Basidia 37–54 × 9–14 µm, tetrasporigera fibulata. Acies lamellarum heterogenea. Cheilocystidia 15–50 × 3–10 µm, cylindracea vel formae irregularis. Pileipellis cutis e hyphis 2–4 µm latis pigmento intracellulari vel incrustato formata; fibulae abundantes. Habitat ad terram in silva frondosa.

Holotypus: RUSSIA; Primorsky Territory, Kedrovaya Pad Nature Reserve, vicinities of the Second Zolotoy stream, 43°06'37" N, 131°31'31" E, 20 Aug. 2005, *leg. O. Morozova, LE 253773.*

Etymology: *pallidus* = pale, *carpum* = fruit (body), referring to the pale basidiomes.

Macrocharacters — Pileus 80–130 mm broad, plano-convex with applanate centre and straight margin, hygrophanous, slightly translucently striate at margin, pale brownish, pallescent on drying in radial streaks, glabrous, radially rugulose. Lamellae crowded, adnate-emarginate, to 10 mm broad, white then pinkish with irregular concolorous edge. Stipe 140–160 × 17–20 mm, cylindrical, white, innately longitudinally fibrillose, glabrous, base with white tomentum. Flesh white. Odour farinaceous then reminiscent of hazel nuts. Taste mild.

Microcharacters — Spores 7.0–9.2 × 6.0–7.5 µm, Q = 1.0–1.3, subisodiametrical, with 6–7 angles in side view. Basidia 37–54 × 9–14 µm, narrowly clavate, clamped. Lamellae edge heterogeneous. Cheilocystidia 15–50 × 3–10 µm, cylindrical or irregularly shaped, colourless. Pileipellis a cutis of 2–4 µm wide, cylindrical sometimes slightly ascending hyphae. Pigment intracellular, in some hyphae of subpellis slightly incrusting. Hymenophoral- and pilei-trama regular, made up of short, inflated elements, 40–120 × 5–10 µm. Clamps numerous in the pileipellis.

Habitat — On soil in broad-leaved forest (*Quercus mongolica*, *Tilia amurensis*, *Acer* spp., *Alnus* spp.).

Comments — Within the group of tricholomatoid species of subgenus *Rhodopolia*, only a few species have well-developed cheilocystidia. *Entoloma noordeloosii* Hauskn., known from Central Europe, has larger spores and lacks incrusting pigment. *Entoloma inusitatum* Noordel. et al., another widespread European species, differs by smaller basidiomes with sordid brown colour, larger spores, and more intensely incrusted hyphae in the uppermost layer of the pileus. *Entoloma kallioi* Noordel. is a much darker species with filiform

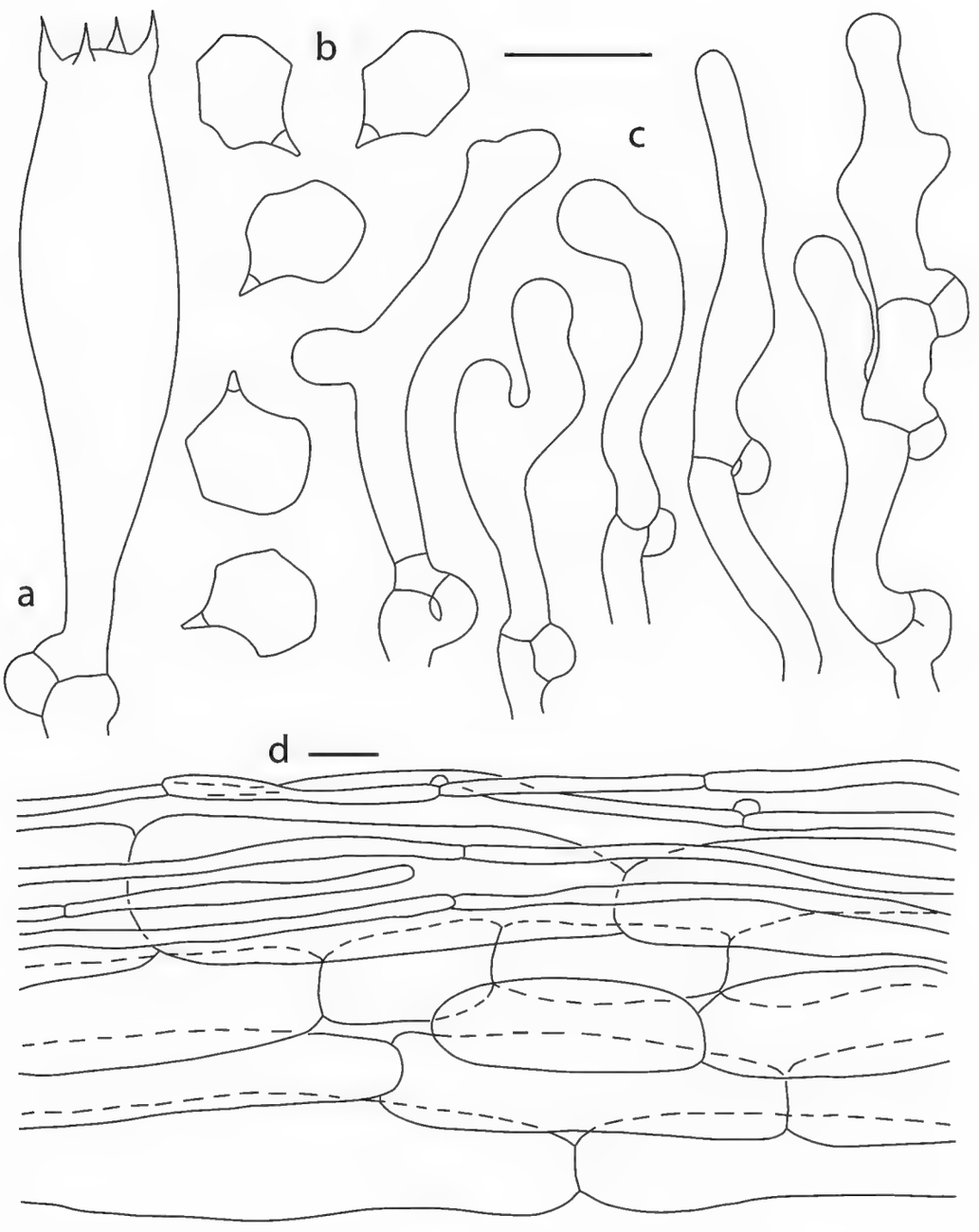

Fig. 3. *Entoloma pallidocarpum*. Basidium (a), spores (b), cheilocystidia (c), and pileipellis (d). All figs from holotype. Bar = 10 μm.

cheilocystidia (Noordeloos 2004). No similar species could be found in Horak (1980).

4. *Entoloma angustispermum* Noordel. & O.V. Morozova, **sp. nov.**

MycoBank 515680 Fig. 4, Plate 1.4

Pileus 15–20 mm latus, semiglobosus demum plano-convexus centro depresso, paulo hygrophanus, paulisper translucente striatus, alutaceus, pallide brunneolus, margine pallidior centro obscurior minute squamuloso. Lamellae adnato-emarginatae, albae

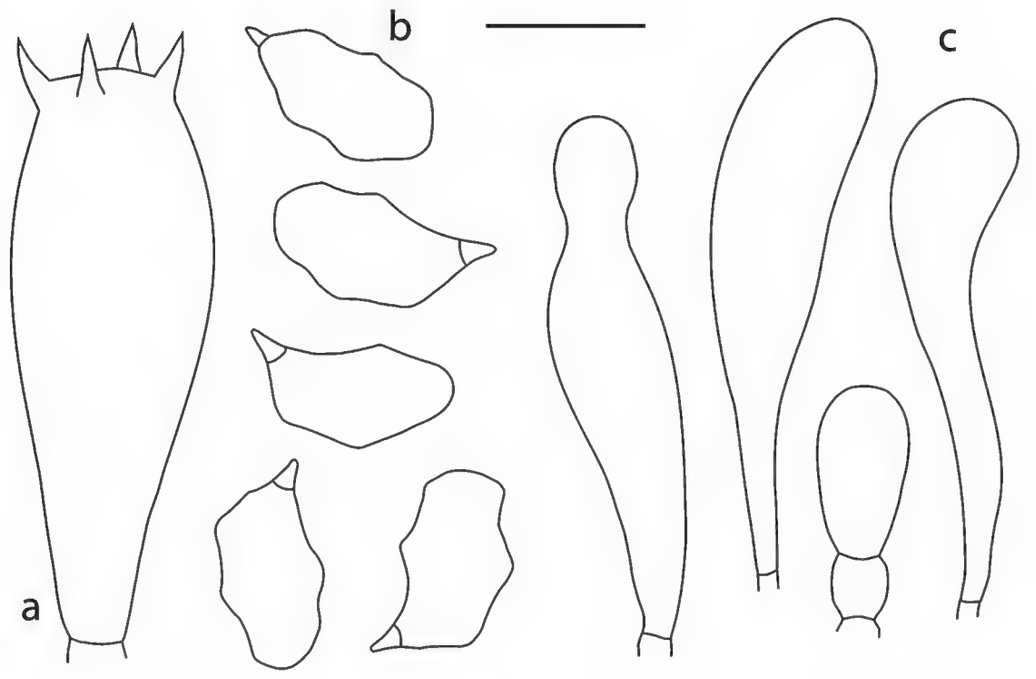

Fig. 4. *Entoloma angustispermum*. Basidium (a), spores (b), and cheilocystidia (c). All figs from holotype. Bar = 10 µm.

demum rosae acie concolor. Stipes 60–80 × 2.5 mm, cylindraceus vel compressus, griseolus, politus, basi albotomentosa. Caro superficie concolor odore saporeque indistinctis. Sporae 9.0–13.0 × 5.5–7.6 µm, Q=1.3–1.8(2.1), 6–8 angulatae. Basidia 21–32 × 11.8–13.5 µm tetrasporigera efibulata. Acies lamellarum heterogenea. Cheilocystidia 12–40 × 7–15 µm, cylindracea vel clavata interdum septata. Pileipellis cutis trichoderma transient, elementis terminalibus cylindraceis vel clavatis 30–70 × 9–19 µm pigmento intracellulari; fibulae desunt. Granula lucentia adsunt. Habitat ad terram in silva frondosa.

Holotypus: RUSSIA; Primorsky Territory, Kedrovaya Pad Nature Reserve, vicinities of the Second Zolotoy stream, 43°06'37" N, 131°31'31" E, 20 Aug. 2005, *leg. O. Morozova, LE 253774.*

Etymology: *angustus* = narrow, referring to the narrow spores.

Macrocharacters — Pileus 15–20 mm broad, hemispherical when young, expanding to plano-convex with depressed centre, slightly hygrophanous, translucently striate to half of radius, smooth, pale beige, with darker, minutely squamulose centre. Lamellae adnate-emarginate, first white then pink with concolorous edge. Stipe 60–80 × 2.5 mm, cylindrical or compressed with longitudinal groove, greyish beige, polished, glabrous, base with white tomentum. Context whitish. Odour indistinct. Taste indistinct.

Microcharacters — Spores 9.0–13.0 × 5.5–7.6 µm, Q=1.3–1.8(2.1), heterodiametrical, with 6–8 angles in side view. Basidia 21–32 × 11.8–13.5 µm, clavate, no clamps seen. Lamellae edge heterogeneous. Cheilocystidia 15–30

× 6–7 μm, cylindrical or clavate, sometimes septate, colourless. Pileipellis a cutis with transition to a trichoderm, made up of cylindrical to clavate elements, 30–70 × 9–19 μm. Brilliant granules present in trama. Pigment intracellular in pileipellis. Clamp connections absent.

Habitat — On soil in the broad-leaved forest (*Quercus mongolica*, *Tilia amurensis*, *Acer* spp., *Alnus* spp.).

Comments — *Entoloma angustispermum* keys out in section *Cyanula* stirps *Sarcitulum* based on the pale brown colour, translucently striate pileus, and polished stipe (Noordeloos 2004). No European species has such narrow spores. *Entoloma mutabilipes* Noordel. & Liiv from Europe also is similar, but usually has a distinctly blue stipe, particularly when young, and smaller spores (Noordeloos & Liiv 1992). No similar species could be found in Horak (1980).

5. ***Entoloma roseoflavum*** Noordel. & O.V. Morozova, **sp. nov.** Fig. 5, Plate 1.6

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Pileus 13–45 mm latus, semiglobosus demum plano-convexus vel applanatus centro depresso, paulo hygrophanus, translucente striatus, alutaceus, pallide brunneolus ad albido adumbratione roseolus margine pallidior glabro centro flavobrunneo squamuloso. Lamellae adnato-emarginatae, albae demum rosae acie concolor. Stipes 50–100 × 2–3 mm, cylindraceus vel compressus, albus demum flavidus, politus, basi albotomentosa. Caro alba odore saporeque indistinctis. Sporae 8.3–11.0 × 6.5–7.8 μm, Q=1.2–1.5, 5–7 angulatae. Basidia 29–32 × 9–12 tetrasporigera efibulata. Acies lamellarum sterilis. Cheilocystidia 39–81 × 5–12 μm, cylindracea vel clavata, septata. Pileipellis cutis trichoderma transient, elementis terminalibus clavatis 10–22 μm latus pigmento intracellulari; fibulae desunt. Granula lucentia adsunt. Habitat ad terram in silva frondosa humida.

Holotypus: RUSSIA; Primorsky Territory, Kedrovaya Pad Nature Reserve, the right bank of the Kedrovaya River, 43°05'56" N, 131°33'21" E, 17 Aug. 2005, *leg. O. Morozova, LE 253775.*

Etymology: *roseus* = pink, *flavum* = yellow, referring to the colour of the basidiomes.

Macrocharacters — Pileus 13–45 mm broad, hemispherical when young, expanding to plano-convex then applanate with depressed centre, slightly hygrophanous, translucently striate to half of the radius, squamulose at centre, glabrous towards margin, pale beige, buff with a pink hue, with contrasting dark yellowish brown centre. Lamellae adnate-emarginate with decurrent tooth, first white then pink with irregular concolorous edge. Stipe 50–100 × 2–3 mm, cylindrical or compressed with longitudinal groove, white then yellowish, polished, glabrous, base with white tomentum. Context white. Odour indistinct. Taste indistinct.

Microcharacters — Spores 8.3–11.0 × 6.5–7.8 μm, Q=1.2–1.5, heterodiametrical, with 5–7 angles in side view. Basidia 29–32 × 9–12 μm, clavate, clampless. Lamellae edge sterile. Cheilocystidia 39–81 × 5–12 μm,

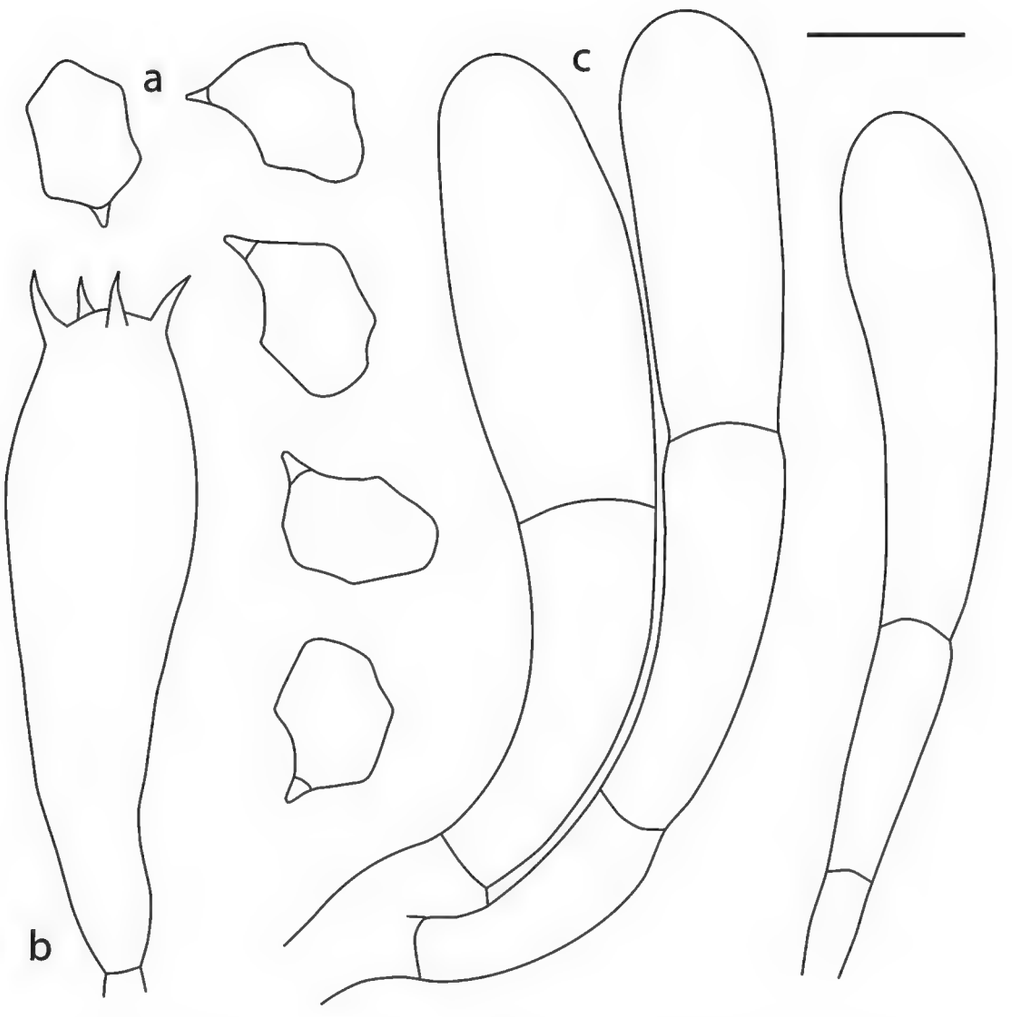

Fig. 5. *Entoloma roseoflavum*. Spores (a), basidium (b), and cheilocystidia (c). All figs from holotype. Bar = 10 μm.

cylindrical or clavate, septate, colourless. Pileipellis a cutis with transition to a trichoderm made up of clavate terminal elements, 10–22 μm wide. Pigment intracellular. Brilliant granules present. Clamp connections absent.

Habitat — On soil in the flood plain forest.

Comments — *Entoloma roseoflavum* is a pale member of section *Cyanula*, characterized mainly by the pale pinkish pileus with yellow centre and yellowish stipe. It is distinguished from the European species with pink tinges as follows: *Entoloma ritae* Noordel. & Wölfel has also a pinkish pileus and yellow stipe but clearly differs microscopically by the larger spores, presence of clamp-connections, and pileipellis structure (Wölfel & Noordeloos 1997); *E. roseotinctum* Noordel. & Liiv has grey tinges in pileus and stipe and lageniform cheilocystidia (Noordeloos & Liiv 1992); *E. roseum* (Longyear) Hesler and

E. reinwaldii Noordel. & Hauskn. differ by having more intensely pink basidiomes without yellow tinges (Hesler 1967, Noordeloos & Hausknecht 2000). *E. roseoluteolum* G.M. Gates & Noordel. from Tasmania is superficially similar but differs by the slight violaceous tinges in the pileus and the fertile lamella edge without cheilocystidia (Gates & Noordeloos 2007).

6. *Entoloma subcaesiellum* Noordel. & O.V. Morozova, **sp. nov.**

MycoBank 515679 Fig. 6, Plate 1.5

Pileus 5–20 mm latus, conicus vel semiglobosus demum plano-convexus, paulo hygrophanus, translucente striatus, caeruleus, demum margine pallide violaceogriseo, centro squamuliscum. Lamellae adnato-emarginatae, albae demum rosae acie concolor. Stipes 45–70 × 2–3 mm, cylindraceus vel compressus, caeruleus, politus, basi albotomentosa. Caro superficie concolor odore saporeque indistinctis. Sporae 8.0–11(–12.0) × 6.0–8.0 µm, Q = 1.2–1.5, 5–7 angulatae. Basidia 21–34 × 8–11.5 µm, bi- vel tetrasporigera efibulata. Acies lamellarum sterilis vel heterogenea. Cheilocystidia 12–40 × 7–15 µm, clavata vel lageniformia. Pileipellis cutis trichoderma transient, elementis terminalibus clavatis 30–90 × 7–21 µm pigmento caeruleo intracellulari; fibulae desunt. Granula lucentia adsunt. Habitat ad terram in silva frondosa humida.

***Holotypus**: RUSSIA;* Primorsky Territory, Kedrovaya Pad Nature Reserve, the right bank of the Kedrovaya River, 43°05'56" N, 131°33'21" E, 17 Aug. 2005, *leg. O. Morozova, LE 253776.*

Etymology: named after its similarity to *Entoloma caesiellum.*

Macrocharacters — Pileus 5–20 mm broad, conical to hemispherical, expanding to plano-convex, with or without small umbo, or slightly depressed centre, faintly hygrophanous, translucently striate up to the centre, bright blue with fine darker blue squamules at centre, glabrous towards margin, fading to light purplish gray at margin on drying. Lamellae adnate-emarginate, almost free, first white then pink with concolorous, straight edge. Stipe 45–70 × 2–3 mm, cylindrical or compressed with longitudinal groove, blue, concolorous with pileus, smooth, glabrous, polished, matt at base with white tomentum. Odour indistinct. Taste indistinct.

Microcharacters — Spores 8.0–11(–12.0) × 6.0–8.0 µm, Q = 1.2–1.5, heterodiametrical, with 5–7 angles in side view. Basidia 21–34 × 8–11.5 µm, clavate, 2–4 spored, clampless. Lamellae edge sterile or heterogeneous. Cheilocystidia 12–40 × 7–15 µm, mostly shorter than the basidia, broadly clavate or lageniform, colourless. Pileipellis a cutis with transitions to a trichoderm, particularly at centre of pileus, made up of cylindrical to clavate elements, 30–90 × 7–21 µm. Pigment intracellular. Brillliant granules present in hymenophoral- and pilei-trama. Clamps absent.

Habitat — On soil in the flood plain forest and broad-leaved forest (*Quercus mongolica*, *Tilia amurensis*, *Acer* spp., *Alnus* spp.).

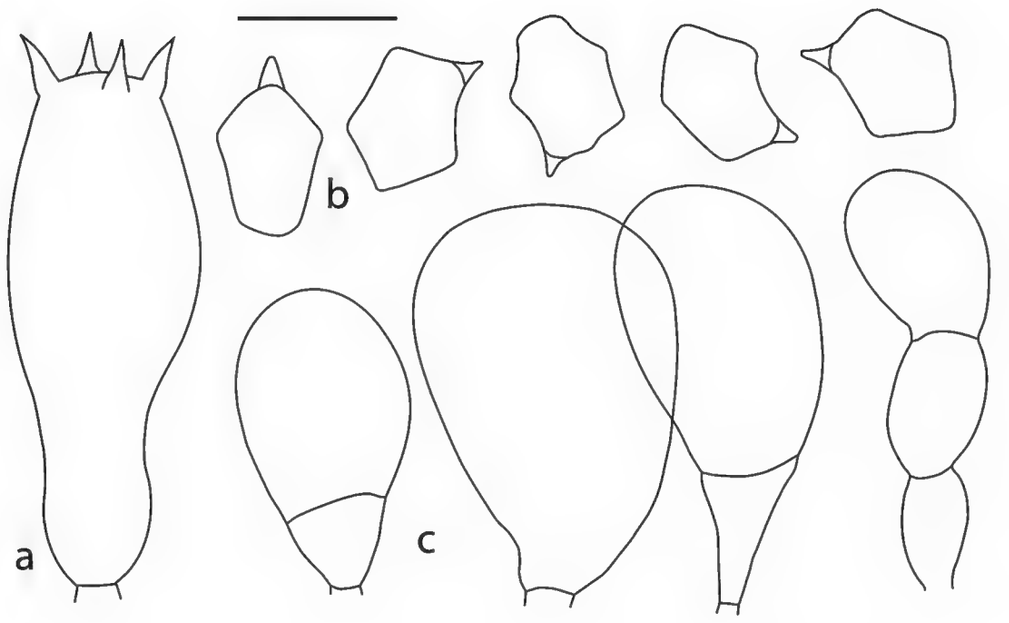

Fig. 6. *Entoloma subcaesiellum*. Basidium (a), spores (b), and cheilocystidia (c). All figs from holotype. Bar = 10 µm.

Additional Collections examined — **RUSSIA. Primorsky Territory, Kedrovaya Pad Nature Reserve**, vicinities of the Second Zolotoy stream, 43°06'37" N, 131°31'31" E, 20 Aug. 2005, leg. *O. Morozova, LE 253777*; **Kedrovaya Pad Nature Reserve**, the right bank of the Kedrovaya River, 43°05'56" N, 131°33'21" E, 17 Aug. 2005, leg. *O. Morozova, LE 253779*.

Comments — *Entoloma caesiellum* differs by having slenderer and longer cheilocystidia, and a more slate blue-grey, convex-umbilicate pileus. This species also strongly resembles *E. chalybeum* var. *lazulinum* (Fr.) Noordel., differing however by the lack of blue tinges in the lamellae, and the concolorous lamella edge with relatively short and broad cheilocystidia which do not arise from a strand of hyphae running along the lamella edge (*serrulatum*-type, see Noordeloos 2004).

II. New records

7. ***Entoloma caesiellum*** Noordel. & Wölfel, in Noordeloos et al., Z. Mykol. 61(2): 185 (1995) Fig. 7, Plate 1.7

Macrocharacters — Pileus 30–40 mm broad, hemispherical when young, expanding to plano-convex with depressed centre, slightly hygrophanous, translucently striate to half of the radius, centrally squamulose, smooth towards margin, light beige, with delicate blue tinge on the margin. Lamellae adnate-emarginate, first white then pink with irregular concolorous edge. Stipe

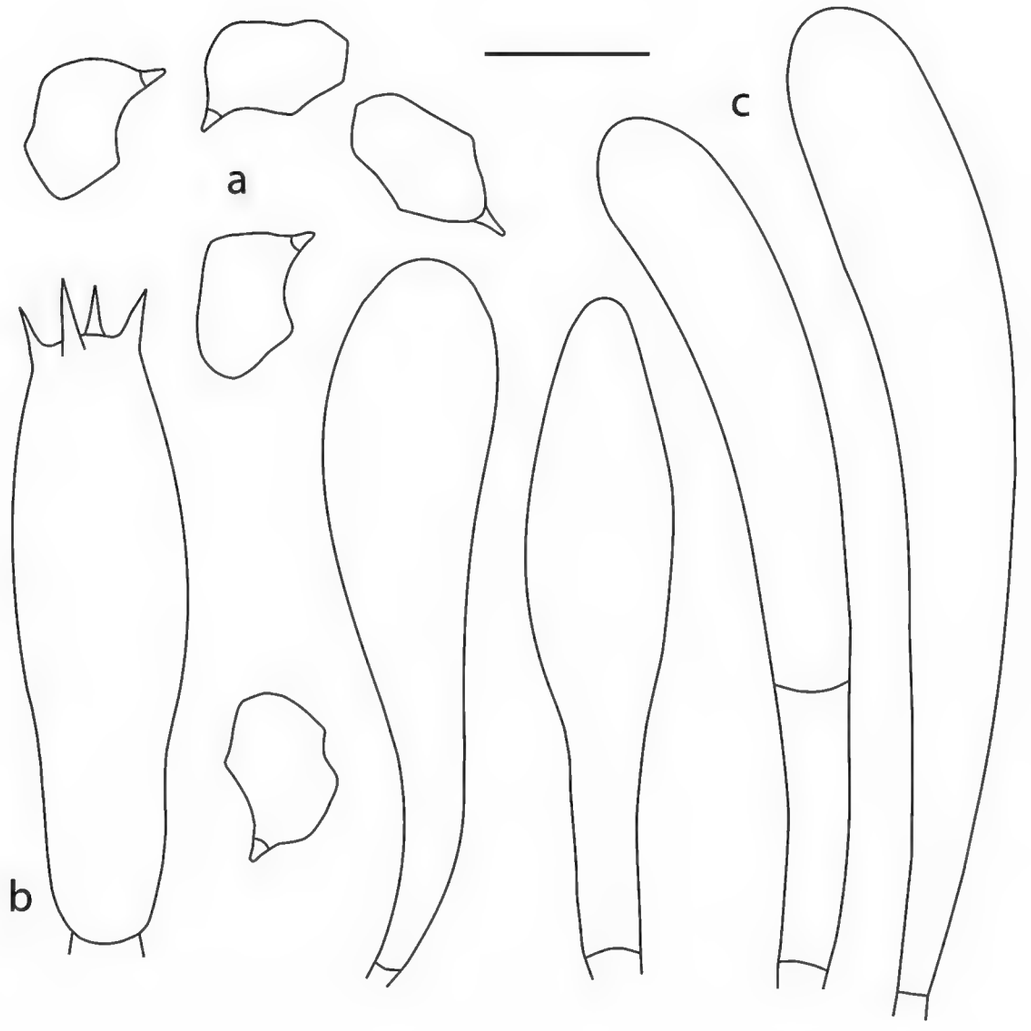

Fig. 7. *Entoloma caesiellum*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253780. Bar = 10 μm.

70–80 × 2–3 mm, cylindrical or compressed with longitudinal groove, sky blue, polished, glabrous, base with white tomentum. Odour slightly spicy. Taste indistinct.

Microcharacters — Spores 8.5–10.4 × 5.7–7.8 μm, Q = 1.3–1.6, heterodiametrical, with 5–7 angles in side view. Basidia 31.2–43.5 × 9.0–10.5 μm, clampless. Lamellae edge sterile. Cheilocystidia 28.6–72.8 × 7.8–16.9 μm, narrowly clavate to lageniform, colourless. Pileipellis a cutis with transition to a trichoderm. Pigment intracellular. Clamps absent.

Habitat — on soil in *Alnus hirsuta* and *Quercus mongolica* forest.

Collection examined — **RUSSIA. Primorsky Territory: Kedrovaya Pad Nature Reserve**, the left bank of the Kedrovaya River, southern slope of the Gakkelevsky mountain ridge, 43°06'10" N, 131°33'34" E, 19 Aug. 2005, leg. *O. Morozova, LE 253780.*

Comments — *Entoloma caesiellum* is characterized by the conical to convex with umbilicate centre, translucently striate, brownish beige pileus with minute blackish blue squamules in the central part and pale blue-lilac tinge in the marginal zone, white then pink lamellae with concolorous edge, and blue-grey, polished stipe, small spores, and relatively slender cheilocystidia. So far this species had been known only from the type locality in Italy where it was found in a subalpine peat-bog with *Betula* and *Alnus* (Noordeloos 2004), and in a submontane forest in Spain (Vila & Caballero 2007). *Entoloma pseudocoelestinum* Arnolds is similar but has a brown-tinged pileus and lacks cheilocystidia. *Entoloma chalybeum* var. *lazulinum* differs by the bluish lamellae with brown edge and larger spores (Noordeloos 1992). *Entoloma decolorans* E. Horak from New Zealand has a darker, entirely squamulose, non-translucent striate pileus (Horak 1973). *Entoloma transmutans* G.M. Gates & Noordel. from Tasmania differs by having pinkish purple tinges in the expanding pileus, and much smaller spores (Gates & Noordeloos 2007).

8. ***Entoloma parasericellum*** Corner & E. Horak, in Horak, Beih. Nova Hedwigia 65: 97 (1980) Fig. 8, Plate 1.8

Macrocharacters — Pileus 8–28 mm broad, hemispherical when young, expanding to plano-convex and applanate with depressed centre, not hygrophanous, not translucently striate, radially finely silky-fibrillose, whitish to cream-coloured. Lamellae adnate, whitish then pink, with serrulate concolourous edge. Stipe 55–70 × 3–5 mm, cylindrical, slightly broadened towards base, sometimes with longitudinal groove, white, pruinose at apex, white tomentum at base. Context whitish. Odour strong like aromatic soap. Taste indistinct.

Microcharacters — Spores 9.3–13.0 × 6.0–8.0 µm, Q=1.3–1.9, heterodiametrical, with 5–7 angles in side view. Basidia 28.5–39.0 × 10.0–11.0 µm, clavate, clampless. Lamellae edge sterile. Cheilocystidia cylindrical or narrowly clavate, sometimes septate, 33.0–90.0 × 4.0–6.0 µm. Pileipellis a cutis made up of hyphae 4.0–10.0 µm wide with pale intracellular pigment. Clamps absent.

Habitat — On soil in broad-leaved forest (*Quercus mongolica*, *Tilia amurensis*, *Acer* spp., *Alnus* spp.).

Collection examined — **RUSSIA. Primorsky Territory: Kedrovaya Pad Nature Reserve**, vicinities of the Second Zolotoy stream, 43°06'37" N, 131°31'31" E, 20 Aug. 2005, leg. *O. Morozova and E. Popov, LE 253788.*

Comments — This collection is strongly reminiscent of the very widespread *Entoloma sericellum* (Fr.) P. Kumm., from which it mainly differs by the rather persistent white colour, the lack of clamp connections, sterile lamella edge, and predominantly 5–7 angled spores. The description and illustration of

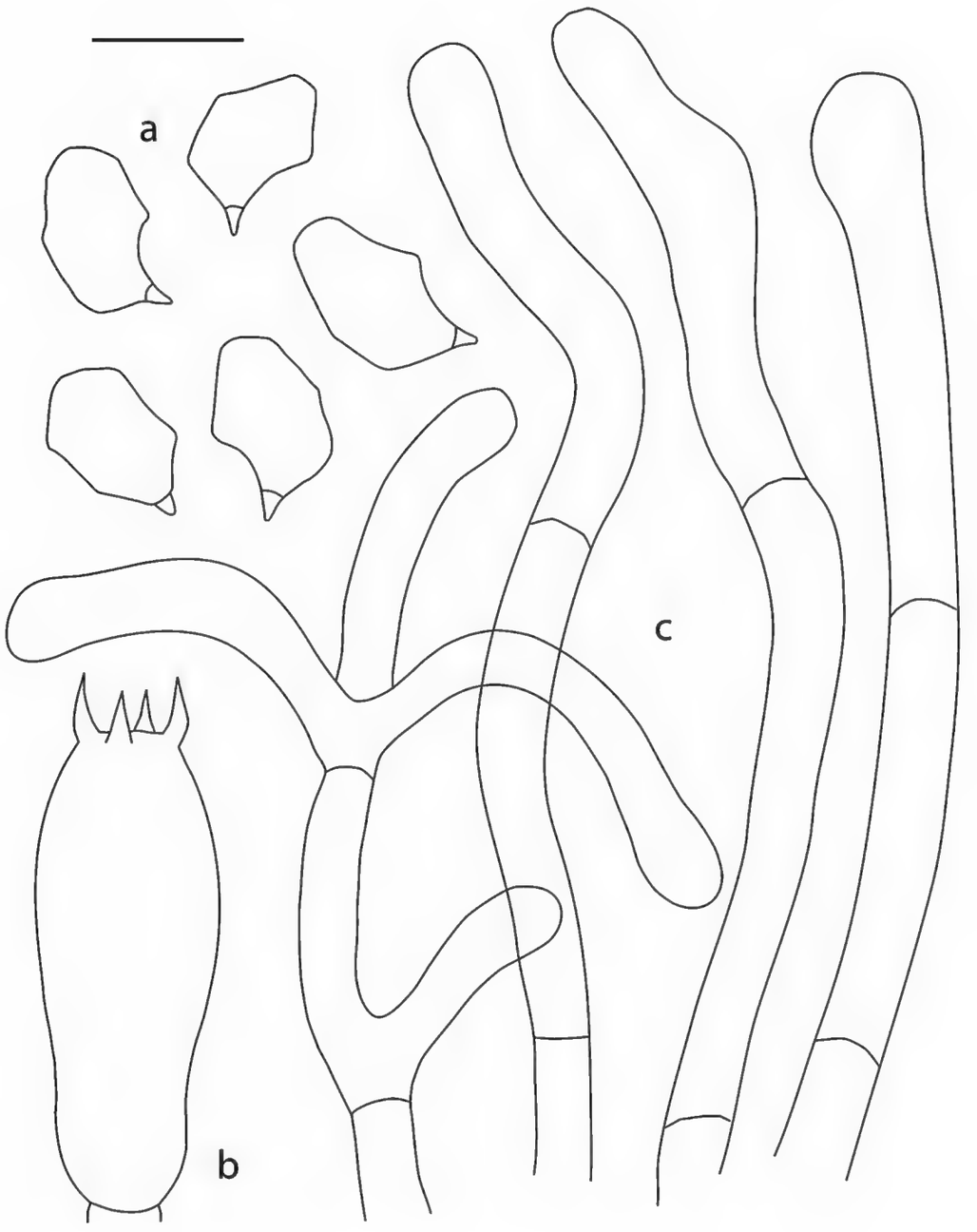

Fig. 8. *Entoloma parasericellum*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253788. Bar = 10 μm.

E. parasericellum fit very well (Horak 1980). Our specimen differs from it only by the strong aroma with a saponaceous tinge. However, this species has only been recorded from New Guinea and Sabah to date. *Entoloma albidosimulans* G.M. Gates & Noordel. from Tasmania is also very similar, but differs by having a more differentiated pileipellis tending to a trichoderm (Gates & Noordeloos 2007). *Entoloma neosericellum* E. Horak from New Zealand is similar, differing by having abundant clamp connections (Horak 2008).

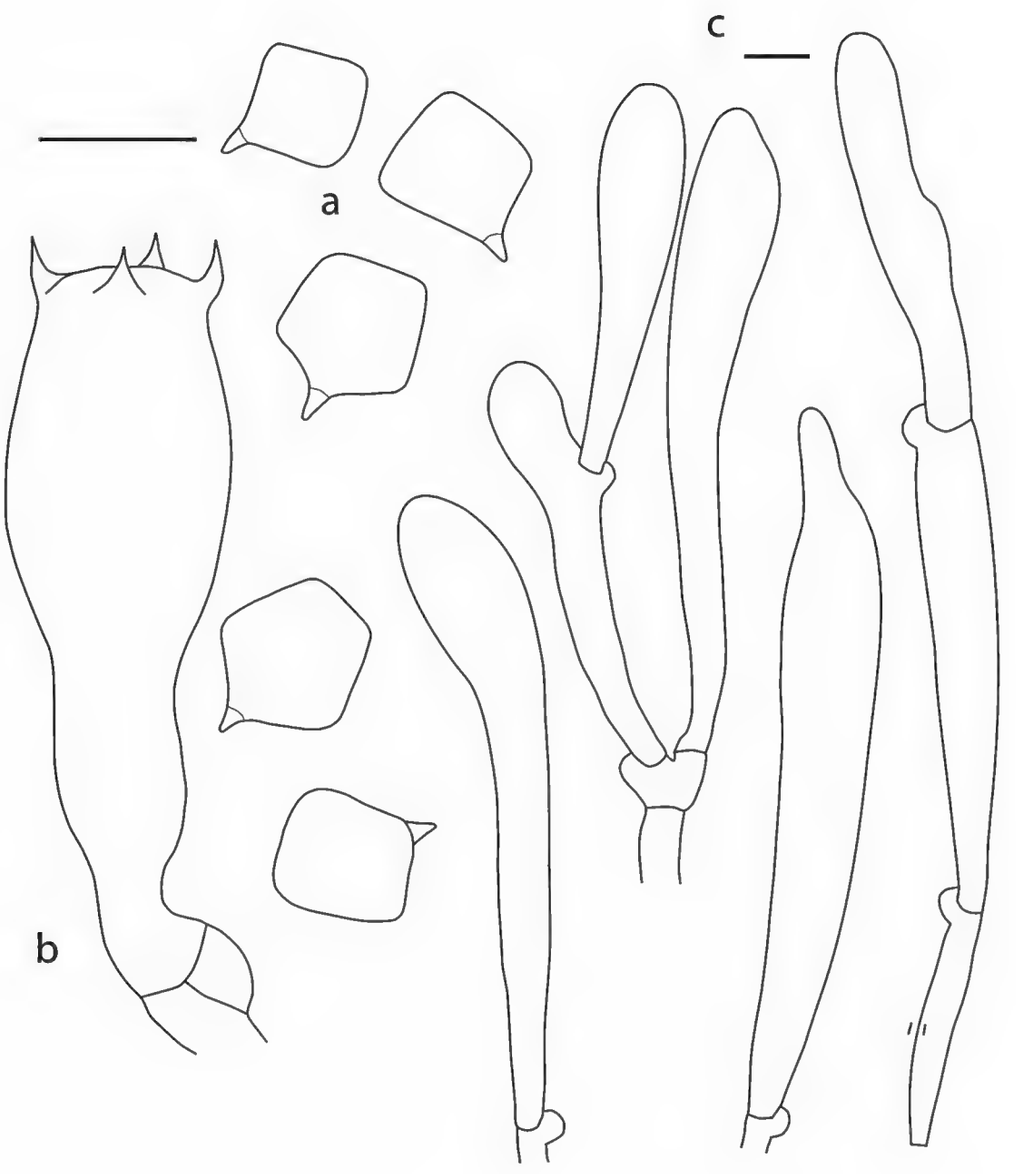

Fig. 9. *Entoloma quadratum*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253783. Bar = 10 µm.

9. *Entoloma quadratum* (Berk. & M.A. Curtis) E. Horak, Sydowia 28: 190 (1976, « 1975 ») Fig. 9.

Macrocharacters — Pileus 10–40 mm broad, conical or campanulate with distinct acute papilla, hygrophanous, translucently striate, salmon pink, yellowish orange with paler serrulate margin. Lamellae adnate-emarginate, almost free, ventricose, first salmon pink then pink with concolorous or paler edge. Stipe 55–130 × 2–4 mm, cylindrical or slightly broadened towards base, longitudinally striate, often twisted, pruinose in the upper part, concolorous with pileus or paler, base with white tomentum. Smell indistinct. Taste indistinct.

Microcharacters — Spores 8.3–10.4 × 7.8–9.1 µm, Q=1.0–1.2, cuboid. Basidia 48–62 × 11,7–13 µm, 4 spored, clamped. Lamellae edge sterile. Cheilocystidia of *serrulatum*-type, with dense clusters of septate hyphae with cylindrical or narrowly clavate terminal elements 52–96 × 10–15.5 µm, without pigment. Pileipellis a cutis consisting of cylindrical hyphae. Pigment intracellular. Clamps present.

Habitat: on soil in the *Alnus hirsuta* and *Quercus mongolica* forest and in the broad-leaved forest (*Quercus mongolica*, *Tilia amurensis*, *Acer* spp.).

Collections examined — **RUSSIA. Primorsky Territory: Kedrovaya Pad Nature Reserve,** the left bank of the Kedrovaya River, the right bank of the Kedrovaya River, 43°05'56" N, 131°33'21" E, 17 Aug. 2005, leg. *E. Popov, LE 253783*; the southern slope of the Gakkelevsky mountain ridge, 43°06'10" N, 131°33'34" E, 19 Aug. 2005, leg. R.H. Petersen; *LE 253781*; vicinity of the Second Zolotoy stream, 43°06'37" N, 131°31'31" E, 20 Aug. 2005, leg. *O. Morozova, LE 253782.*

Comments — *Entoloma quadratum* is very easy to recognize on its salmon pink to orange basidiomes and cuboid spores. It is widespread, and locally common in North America and Japan, and extends also in eastern Asia (Horak 1976, 1980; Noordeloos & Hausknecht 2007). It was reported as *E. salmoneum* (Peck) Sacc. from Kedrovaya Pad Nature Reserve by Vassiljeva (1973).

The complex of *Entoloma serrulatum* (Fr.) Hesler

In the survey of the Kedrovaya Pad Nature Reserve, several collections have been made of taxa belonging to the cosmopolitan, and morphologically very plastic, complex of *Entoloma serrulatum*, characterized by the so-called *serrulatum*-type of lamella edge, which is a dense strand of hyphae running along the lamella edge with more or less clavate terminal endings, often in irregular, dense clusters, causing a fimbriate lamella edge when examined with a hand lens. Usually these elements or "cheilocystidia" are filled with a deep blue or blackish blue, rarely brown or purple, intracellular pigment. Many species have been distinguished in this group, mainly based on colour differences of the pileus and stipe combined with slight differences in spore size and shape. At present we feel that a thorough revision using molecular markers would contribute to a better understanding of the diagnostic value of these characters.

The following collections have been named using existing literature:

10. *Entoloma gomerense* Wölfel & Noordel., Öst. Z. Pilzk. 10: 192 (2001)

Fig. 10, Plate 1.9

Macrocharacters — Pileus 7–10 mm broad, plano-convex with depressed centre, slightly hygrophanous, translucently striate, very dark grayish blue with purple or brown tinge in centre and stripes, almost white between them,

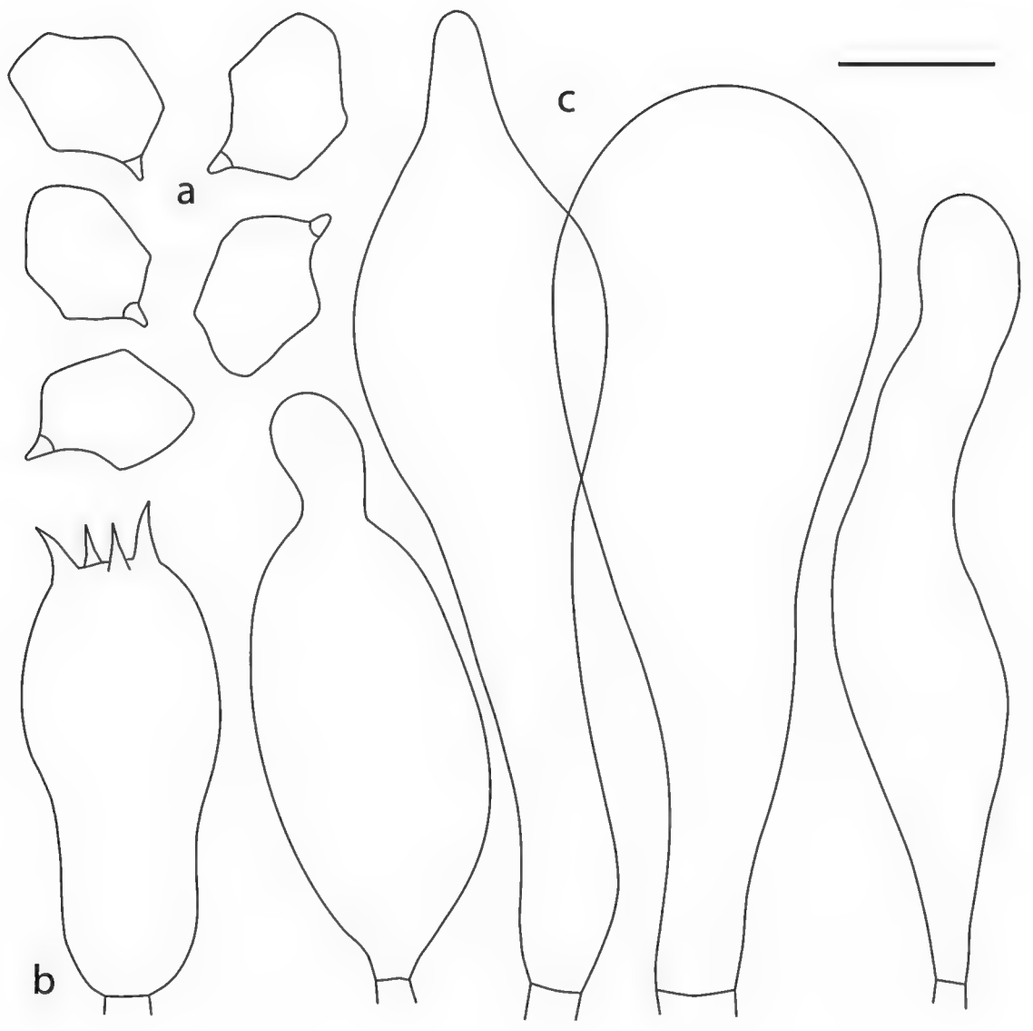

Fig. 10. *Entoloma gomerense*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253784. Bar = 10 µm.

covered by grayish blue scales. Lamellae adnate-emarginate with small decurrent tooth, grayish pink with serrulate blackish purple edge. Stipe 22–25 × 1 mm, cylindrical, dark grayish blue, polished, glabrous, base with white tomentum. Context concolorous with the surface, whitish in the inner part. Odour indistinct. Taste indistinct.

Microcharacters — Spores 8.5–10.5(11.7) × 6.5–8.5 µm, Q=(1.1)1.3–1.5, heterodiametrical, with 5–6 angles in side view. Basidia 22–26 × 9–12 µm, clavate to broadly ellipsoid, clampless. Lamellae edge sterile. Cheilocystidia 20–73 × 8–22 µm, broadly clavate or lageniform with dark intracellular pigment. Pileipellis a cutis with transition to a trichoderm. Pigment intracellular. Clamps absent.

Habitat — on soil and decayed wood in the flood plain forest.

Collection examined — **RUSSIA. Primorsky Territory: Kedrovaya Pad Nature Reserve,** the right bank of the Kedrovaya River, 43°05'56" N, 131°33'21" E, 17 Aug. 2005, leg. *O. Morozova, LE 253784.*

Comments — The small dark grayish blue basidiomes with deeply translucently striate pileus and blackish blue, *serrulatum*-type lamella edge are distinctive for this tiny *Cyanula*. Originally described from the Island of Gomera, Islas Canarias, Spain, it now has also been recorded from a few European localities (Noordeloos 2004). It seems to prefer moist places with mosses and peaty soil.

11. *Entoloma caesiocinctum* (Kühner) Noordel., Persoonia 11(4): 470 (1982)

Fig. 11

Macrocharacters — Pileus 20–25 mm broad, infundibuliform, slightly hygrophanous, translucently striate, radially fibrillose, dark grayish blue and squamulose at centre, grayish brown from the centre becoming grayish blue at margin. Lamellae subdecurrent or arcuate, first blue, then grayish pink with serrulate dark blue edge. Stipe 55–60 × 3–5 mm, cylindrical or compressed with longitudinal groove, dark blue or grayish blue, glabrous, polished, base with white or grayish tomentum. Context concolour with the surface, inner part whitish. Odour spicy. Taste of starch.

Microcharacters — Spores 7.5–11.0 × 5.5–7.5 μm, Q=1.2–1.6, heterodiametrical, with 5–7 angles in side view. Basidia 21–31 × 8–12 μm,

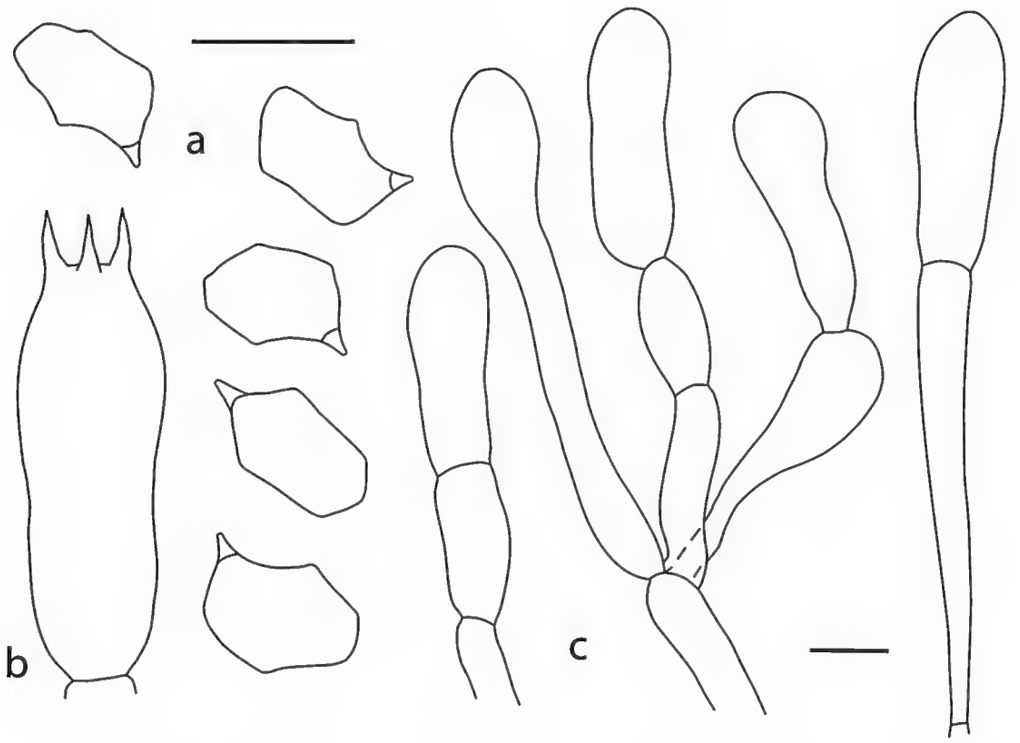

Fig. 11. *Entoloma caesiocinctum*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253786. Bar = 10 μm.

clavate, clampless. Lamellae edge sterile. Cheilocystidia of *serrulatum*-type, with dense clusters of septate hyphae with cylindrical or narrowly clavate terminal elements 50–120 × 6–10 µm, with bluish intracellular pigment. Pileipellis a cutis with transition to a trichoderm. Pigment intracellular. Clamps absent.

Habitat — On soil in broad-leaved forest (*Quercus mongolica*, *Tilia amurensis*, *Acer* spp., *Alnus* spp.).

Collections examined — **RUSSIA. Primorsky Territory: Kedrovaya Pad Nature Reserve,** the right bank of the Kedrovaya River, 43°05'56" N, 131°33'21" E, 17 Aug. 2005, leg. *O. Morozova, LE 253785*; **Primorsky Territory, Kedrovaya Pad Nature Reserve,** vicinities of the Second Zolotoy stream, 43°06'37" N, 131°31'31" E, 20 Aug. 2005, leg. *O. Morozova, LE 253786*.

Comments — The above collections could be identified as *E. caesiocinctum* due to their predominantly brown, translucently striate pileus, but our specimens differ from the typical *E. caesiocinctum* by the clitocyboid form of the basidiome and slightly smaller spores.

12. *Entoloma violaceoserrulatum* Noordel., Fungi Europaei, 5a: 1038 (2004)

Fig. 12

Macrocharacters — Pileus 26–40 mm broad, infundibuliform, not hygrophanous, not translucently striate, brownish gray with violaceous tinge, entirely squamulose. Lamellae decurrent, grayish pink with serrulate violaceous edge. Stipe 55–70 × 3–5 mm, cylindrical, slightly broadened towards base, with longitudinal groove, bluish gray with violaceous tinge, white at apex, squamulose, base with white tomentum. Context whitish. Smell indistinct. Taste indistinct.

Microcharacters — Spores 8.0–10.5 × 6.0–8.0 µm, Q=1.1–1.6, heterodiametrical, with 5–6 angles in side view. Basidia 22–45 × 11–15 µm, clavate to broadly ellipsoid, clampless. Lamellae edge sterile. Cheilocystidia of *serrulatum*-type, with dense clusters of septate hyphae with cylindrical or clavate terminal elements 50–120 × 10–22 µm, with bluish intracellular pigment. Pileipellis a cutis with transition to a trichoderm, made up of inflated terminal elements, 40–70 × 5–22 µm with blue, intracellular pigment. Brilliant granules abundant in pilei- and hymenophoral-trama. Clamp connections absent.

Habitat — On soil in the flood plain forest.

Collection examined — **RUSSIA. Primorsky Territory: Kedrovaya Pad Nature Reserve,** the right bank of the Kedrovaya River, 43°05'56" N, 131°33'21" E, 17 Aug. 2005, leg. *O. Morozova, LE 253787*.

Comments — The description of *Entoloma violaceoserrulatum* (originally from Finland) characterized by the violaceous tinges in both the pileus and stipe fits this collection well (Noordeloos 2004).

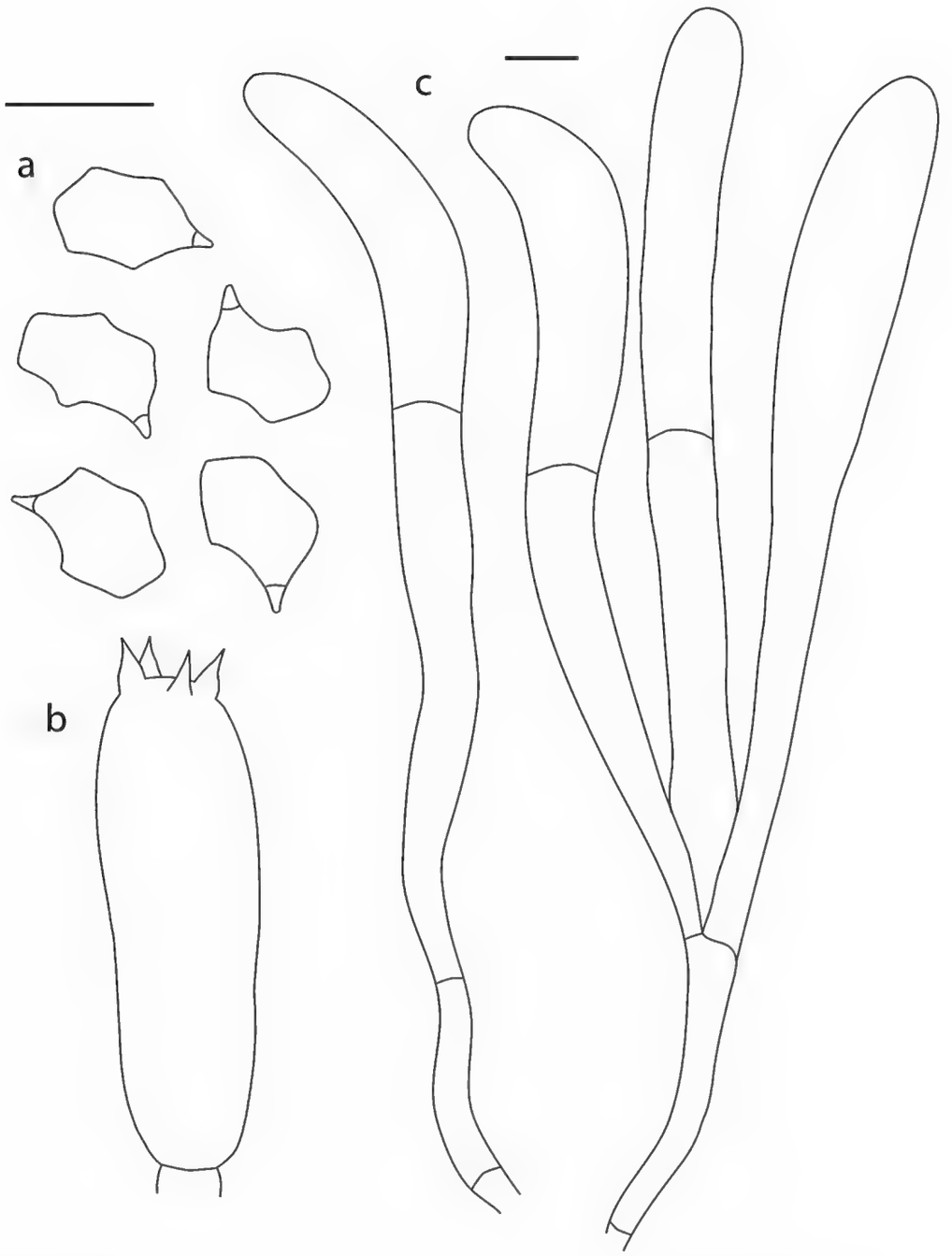

Fig. 12. *Entoloma violaceoserrulatum*. Spores (a), basidium (b), and cheilocystidia (c). From LE 253787. Bar = 10 μm.

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